ISSN 0023-1584, Kinetics and Catalysis, 2006, Vol. 47, No. 5, pp. 797–801. © MAIK "Nauka/Interperiodica" (Russia), 2006.
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CHRONICLE

5th World Congress on Oxidation Catalysis (Sapporo, Japan, September 2005)

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Received November 3, 2005

DOI: 10.1134/S0023158406050211

The town of Sapporo (Japan) is one of the world centers of catalytic science. In the 1950s, Prof. Yu. Horiuti, a prominent Japanese scientist, founded the world's first Research Institute for Catalysis at the University on Hokkaido Island. Presently, the Catalysis Research Center in Sapporo occupies a perfectly well furnished and equipped building constructed two years ago. Nine professors are the supervisors of catalytic studies.

The 5th World Congress on Oxidation Catalysis was held September 25–30, 2005, in Sapporo. The Congress convoked 368 participants, including 201 from Japan, 24 from the United States, 18 from Germany, 18 from Taiwan, and 10 from Russia. There were also representatives from Ghana, Zimbabwe, Nigeria, and some other African countries. The agenda of the Congress included 5 plenary lectures, 7 key lectures, 77 oral reports, and 202 poster papers. Below, we review all of the plenary and key lectures and selected oral reports.

USE OF NEW PHYSICAL METHODS IN THE STUDY OF OXIDATION CATALYSIS

Many of the plenary and key lectures were devoted to in situ studies of catalysis mechanisms using new physical methods. The most impressive results have been obtained by new structure determination methods providing atomic resolution. As distinct from the previous meeting (Potsdam, Germany, 2001), the 5th Congress stated a great increase in the application of new physical methods. It should be mentioned that Japan, Korea, and some other countries have got laboratories well equipped with modern physical instruments and have thus joined the United States, the United Kingdom, and Germany in their advanced research.

In the first plenary lecture, H.-J. Freund (Fritz-Haber Institute, Berlin, Germany) reported a study of oxidation catalysis by atomic-resolution scanning tunneling and atomic force microscopy and by high-sensitivity IR and Raman spectroscopy. The atomic structures of the transition metal oxides VO_x and NbO_x supported on MgO, SiO_2, Al_2O_3, and Fe_3O_4 faces have been studied in detail. The structure of supported Au particles and CO adsorption, methanol oxidation, and oxidative propane dehydrogenation on these particles have also been studied. Attempts to use scanning tunneling microscopy in the spectroscopic mode and to measure single spins on the oxide surfaces by scanning tunneling microscopy are also of interest.

In his key lecture, Y. Iwasawa (University of Tokyo, Japan) reported the application of a new modification of extended X-ray absorption fine structure (EXAFS) measurements to the investigation of adsorption and catalysis at the atomic level. This modification, named DXAFS, is the same method but with energy dispersion. Due to a considerable enhancement of sensitivity, this method can be used in the study of the dynamics of structural changes at the atomic level (its time resolution is <1 s). The use of DXAFS with a time resolution of 2–300 ms has made it possible to study oxygen adsorption on the three-way automotive catalyst $Pt/Ce_2Zr_2O_7$. The mechanism of Ru and Rh cluster decomposition during ethylene hydroformylation on Ru_2/SiO_2 and Rh_2/SiO_2 has also been studied. In this process, the $Rh(CO)(COC_2H_5)$ complex and its ruthenium analogue are intermediates.

B.M. Weikhuysen (Debye Institute, University of Utrecht, the Netherlands) developed a spectroscopic reactor cell for simultaneously recording three types of spectra (DXAFS, UV–visible, and Raman) under catalytic conditions. The catalytic oxidation of CO over noble metals on different supports has been studied, and correlations between the activity and various properties of active sites (charge, interatomic distances, etc.) have been established.

Three physical methods (ESR, UV–visible spectroscopy, and Raman spectroscopy) have been used by A. Brückner (Institute for Applied Chemistry, Berlin-Adlershof, Germany) to carry out in situ studies in one reactor. The activity, structure, and stability of the selective oxidation catalysts VO_x/TiO_2 and VO_x–SO_4/TiO_2 have been studied. The VO_x groups bonded to SO_4 are active sites in the oxidative dehydrogenation of propane and but-1-ene.

The plenary lecture by J.M. Thomas (University of Cambridge, United Kingdom) was devoted to problems of solid-state chemistry in oxidation catalysis. The structures of catalysts and their surfaces have been studied using new structure determination methods: scanning tunneling microscopy, atomic-resolution electron microscopy (including in situ techniques), EXAFS, ESR, etc. Oxidation reactions proceeding via a free radical mechanism, including reactions in solutions, have been studied most comprehensively. The greatest success has been achieved in the selective oxidation of hexane and cyclohexane to adipic acid, $HOOC(CH_2)_4COOH$, which is a valuable intermediate product in the synthesis of caprolactam. A selectivity of 53% at 7.2% conversion was achieved on the initial catalyst (cobalt on aluminophosphate). Using stereochemical models of the incorporation of a hydrocarbon molecule into a zeolite microcavity and new types of zeolites, for instance, $FeAlPO_4$, and Ti silicates, Thomas has achieved higher yields of adipic acid. He explains the high selectivity by the specific arrangement of isolated free-radical and acid–base active sites on the walls of zeolite pores. A possible intermediate product here is H_2O_2. In the reporter's opinion, a new cheap method for the production of adipic acid can be claimed. There is also success in the catalytic techniques for the Prileschajew reaction (olefin epoxidation with organic peracids), for the oxidation of toluene to cresol, and for the oxidation of *para*-cresol to terephthalic acid.

ALKANE OXIDATION

Many fewer studies on catalytic alkane oxidation were presented at the Congress than would be expected from the total number of publications in this area. This is explained by the fact that a lot of studies on methane oxidation have also been presented at representative symposia on natural gas conversion. As for the oxidation of methane, most of the presented works dealt with methane oxidation to synthesis gas.

The thermal aging of a supported rhodium catalyst has been studied by W.Z. Weng (Xiamen University, China). It has been shown by Raman spectroscopy that the superheating of the Rh/Al_2O_3 catalyst to 900°C produces a nonreducible compound and decreases the catalyst's activity.

E. Iglesia (University of California, Berkeley, United States) presented results of a detailed kinetic and isotopic study of methane oxidation to synthesis gas on supported Pt, Ru, and Rh catalysts. This reaction proceeds via a consecutive mechanism including complete combustion and the steam and carbon dioxide conversion of methane. Methane is activated on O…O paired adsorption sites. The reaction rate on Ru and Rh increases with a decrease in the metal cluster size.

There are still only a few works on the partial oxidation of methane on oxides. The partial oxidation of methane and other light alkanes to formaldehyde and methanol on SiO_2-supported catalysts has long been studied by A. Parmaliana (University of Messina, Italy). His report contained structural data for FeO_x/SiO_2 catalysts with a low FeO_x coverage obtained by UV–visible, FTIR, EXAFS, and Mössbauer spectroscopies. The selective oxidation of CH_4 to CH_2O and the oxidative dehydrogenation of C_2H_6 to C_2H_4 and of C_3H_8 to C_3H_6 occur at 400–700°C. Isolated Fe^{3+} ions, two-dimensional FeO_x "stains," and three-dimensional Fe_2O_3 particles were observed on the SiO_2 surface. The two-dimensional (oligomeric) FeO_x particles are the most probable active sites of selective oxidation, while the Fe_2O_3 particles are probably responsible for deep oxidation.

J. Wang (Xiamen University, China) has studied mesoporous iron-containing molecular sieves as catalysts for partial methane oxidation and for propylene epoxidation with H_2O_2. In Wang's opinion, the activity of the catalysts in CH_4 oxidation to CH_2O correlates with the "band gap" (UV–visible absorption edge). The catalysts containing 0.1% $FePO_4$, VO_4, and MoO_4 supported on mesoporous SBA or MCM-41 are the most selective. The highest selectivity at 650°C is 50% at 4% conversion. With K–Fe–NCM-41 at 325°C, the propylene epoxidation selectivity is 82% at <1% conversion.

New catalysts for methane oxidation to methanol were presented by B. Michalkiewicz (Technical University of Szczecin, Poland). The way of carrying out this conversion is similar to the process developed by Catalytica Inc. (160°C, 5 MPa). Methane is reacted with SO_3 and H_2SO_4 to form the ester CH_3OSO_3H along with SO_2 and H_2O. The ester undergoes hydrolysis to form methanol and H_2SO_4. Among the homogeneous catalysts examined, $PtCl_2$ was the best: it afforded a methanol yield of 64.9%.

The mechanism of *n*-butane oxidation to maleic anhydride on $(VO)_2P_2O_7$ remains to be the subject of investigation. F. Cavani (University of Bologna, Italy) presented activity and phase composition data for the $(VO)_2P_2O_7$ catalyst under unsteady-state conditions. The catalyst is not single-phase, contrary to the author's earlier belief. At 360°C, the catalyst is covered with $VOPO_4$, an active, but not selective, phase. Subsequently, this phase is hydrolyzed to form a mixture of VO_x and orthophosphoric acid, which is more selective but less active.

High stability, activity, and selectivity are manifested by iron-doped vanadyl pyrophosphate prepared by intercalating iron acetylacetonate into layered vanadyl benzyl phosphate (K. Srinivasan, Nagoya University, Japan).

G.I. Panov (Boreskov Institute of Catalysis, Novosibirsk, Russia) delivered a key lecture on active oxygen in selective oxidation catalysts. He considered the role of the radical anion $O^{\bullet -}$ in selective oxidation reactions.

$MoVNbTeO_x$, a recently discovered catalyst, is high on the list of frequently reported catalysts for the partial oxidation of propane to acrolein and acrylic acid and for the oxidative ammonolysis of propane. R. Schlögl (Fritz-Haber Institute, Berlin, Germany) reported the use of a high-pressure in situ XPS technique in the study of structural changes in catalysts for propane oxidation to acrolein. He has investigated a series of catalysts arranged in the order of increasing structural complexity, from MoO_3 in different forms to $MoVTeNbO_x$. Under catalytic conditions, these catalysts undergo structural changes yielding nanocrystallites of individual phases. The catalyst surface is enriched in vanadium. The Mo_5O_{14} phase is the most selective. The same catalyst has been studied in other works. W. Ueda (Catalysis Research Center, Hokkaido University, Sapporo, Japan) has used this catalyst in the oxidative ammonolysis of propane. As shown by in situ X-ray diffraction, the near-surface lattice oxygen participates in the selective process. H. Hibst (BASF, Ludwigshafen, Germany) has demonstrated that the $Mo_{10}V^{4+}Nb_2TeO_{42}$ catalyst for partial propane oxidation can be stabilized by Rb or Cs ions. The composition of the new active and stable catalysts is described by the general formula $A_{0.5}[Mo_{5-a-b}V_a^{4+}X_bO_{14}]$ (A = Rb, Cs; $V/Mo < 1$, X is another element). X. Tu (Macromolecular Research Laboratory, Nagoya, Japan) described the preparation of the $MoVNbTeO_x$ catalyst by a new method using tellurium fibers. Propane oxidation on this catalyst results in a high (48%) yield of acrylic acid (63.4% conversion, 75.6% selectivity, 380°C).

NEW CATALYSTS AND REACTIONS

Many reports were devoted to the catalytic properties of gold, which ranked first among the objects reported at the 5th Congress. T.A. Nijhuis (Debye Institute, University of Utrecht, the Netherlands) demonstrated that the hydroxyl groups at the Au/TiO_2 interface activate oxygen to form peroxy groups, which are intermediates in the epoxidation of propylene with an $H_2 + O_2$ mixture.

Supported gold catalysts are very active in the low-temperature oxidation of CO. Gold nanoparticles supported on oxides (TiO_2, SiO_2) or metals (Pd) were recommended as selective catalysts for the oxidation of CO mixed with H_2. M. Haruta (University of Tokyo, Japan) studied the dependence of the catalytic activity of supported Au catalysts on the size of Au particles. These catalysts were found to differ from most oxidation catalysts in that their turnover number (i.e., catalytic activity) increases considerably with a decrease in particle size. Therefore, oxidation reactions on Au are structure-sensitive. It has also been shown that the rate of CO oxidation in the $CO + O_2 + H_2$ mixture on Au/Al_2O_3 is 23 times as high as the oxidation rate of pure CO. By contrast, pure H_2 and hydrogen in the above mixture oxidize on Au/Al_2O_3 at the same rate. Water forming in the $CO + O_2 + H_2$ mixture reacts with active sites of the surface, thus promoting CO oxidation.

Gold nanoparticles supported on TiO_2 nanotubes exhibit high activity in CO oxidation (Shu-Hua Chien, National Taiwan University).

A. Fukuoka (Catalysis Research Center, Hokkaido University, Sapporo, Japan) has synthesized Pt nanowires and nanoparticles by the reduction and photoreduction of Pt complexes in the pores of diameter 3 nm in the mesoporous silicas FSM-16 and HMM-1. The Pt nanowires are active and selective in CO oxidation in the presence of H_2. Their high activity is due to the electron-deficient properties of the Pt surface in contact with FSM-16.

G.I. Hutchings (Cardiff University, Wales) has studied the direct synthesis of H_2O_2 from H_2 and O_2 on an Au–Pt catalyst supported on TiO_2, Fe_2O_3, SiO_2, or active carbon. A synergistic effect is observed in this reaction: the Au–Pd alloys are more active than Au and Pd taken separately. An H_2O_2 formation selectivity close to 100% can be achieved. Similar data concerning the synthesis of H_2O_2 on $Pd–Au/TiO_2$ were reported by T. Ishihara (Kyushu University, Fukuoka, Japan).

In his plenary lecture, N. Mizuno (University of Tokyo, Japan) summarized the results of his recent works on the molecular design of polyoxometallates (POMs) as catalysts for selective oxidation with H_2O_2. The catalytic properties of POMs have attracted much attention, because the acidic and redox properties of heterogeneous and homogeneous POMs can be monitored at the atomic and molecular levels. In recent years, POMs have been employed in the selective oxidation of organic compounds with H_2O_2. Mizuno considered the following three types of the POM-based selective catalysts.

(1) Efficient catalysts for epoxidation with H_2O_2. They are (a) peroxotungstates as complexes in aqueous solution, which efficiently epoxidize various allyl alcohols, and supported polyoxotungstates active in the heterogeneous epoxidation of a wide variety of olefins; (b) porous Keggin-type silicotungstates $[\gamma\text{-}SiW_{10}O_{34}(H_2O)_2]^{4-}$, on which the selectivity of epoxidation involving H_2O_2 exceeds 99%; (c) disubstituted vanadium silicotungstates $[\gamma\text{-}1,2\text{-}H_2SiV_2W_{10}O_{40}]^{4-}$, which can epoxidize olefins using only one equivalent of H_2O_2.

(2) Diiron-substituted silicotungstates as efficient catalysts for the epoxidation of substrates with dioxygen. With such a complex, the selectivity of homogeneous cyclooctene oxidation to cyclooctene oxide is as high as 98% and the turnover number is 10000. The same high activity and selectivity were observed for the oxidation of cyclododecene, oct-1-ene, oct-2-ene, and dec-2-ene.

(3) Microstructured stereoselective POMs. Among them is the tunneling Keggin complex $K_3[Cr_3O(OOCH)_6(H_2O)_3]SiW_{12}O_{40} \cdot 16H_2O$ with channels 0.5×0.8 nm in size. This complex reversibly adsorbs water and organic molecules with two or fewer

C atoms. The entry of two molecules into a cavity is a very selective process. For instance, it is possible to selectively oxidize methanol in a mixture of alcohols without affecting the other alcohols.

A commercial process for the synthesis of acetic acid by direct ethylene oxidation was presented by A. Miyaji (Showa Denko K.K., Oita, Japan). The catalyst $PdH_4SiW_{12}O_{40}$ promoted with tellurium is very active and selective at 150°C. A plant implementing this process was put into operation in 1997 in the town of Oita (Japan). Its annual output capacity is 100000 t.

Researchers continue attempts to use CO_2 as an oxidant. K.H. Li (Taiyuan University of Technology, China) reported the oxidative dehydrogenation of ethylbenzene with CO_2 on a vanadium–titanium oxide catalyst of optimal composition V_3Ti. With this catalyst, a styrene selectivity of 93.1% has been achieved at 9.9% ethylbenzene conversion and 450°C.

CATALYTIC PURIFICATION

The trend today is from hydrogenation desulfurization methods toward oxidative ones. In his key lecture, I.E. Wax (Lehigh University, Bethlehem, Pennsylvania, United States) suggested a new vapor-phase oxydesulfurization method using VO_x (and TiO_x) catalysts on various supports. These catalysts are highly active, selective, and stable in the oxydesulfurization of sulfur-containing organic compounds (COS, CS_2, CH_3SH, CH_3SCH_3, CH_3SSCH_3, thiophene, 2,5-dimethylthiophene). FTIR and Raman spectroscopic studies of the reaction mechanism have demonstrated that the oxydesulfurization proceeds via the Mars–Van Crevelen mechanism.

The oxidative removal of sulfur-containing organic compounds (thiophene, benzothiophene, and others) was also considered by K.J. Xu (Nanjing University, China). In the first step of the process suggested, the sulfur-containing compounds are oxidized to sulfones. The sulfones are decomposed or adsorbed by other materials in the second step. The following materials have been advanced as catalysts: V–P–O, MgO, carbon nanotubes, Ti–MCM-41, SBA-15, ZSM-5, fused SiO_2, and others, of which V–P–O is the most active.

The removal of NO_x from lean gases (containing excess O_2) remains the most important and challenging problem of environmental chemistry. The extensive studies on zeolite (ZSM-5 type) catalysts have been almost terminated because of the low productivity and insufficient chemical stability of these catalysts. In his key lecture, P. Forzatti (University of Milan, Italy) reported the development of Pt–Ba–γ-Al_2O_3 catalysts, which combine the ability to oxidize NO to NO_2 on Pt and to store nitrites and nitrates through the reaction of NO_x with BaO. Toyota Co. was the first to put this method into practice. Mechanistic studies have demonstrated that NO storage can proceed via two routes, specifically, the "nitrate" route, in which NO is oxidized to NO_2 on Pt and the resulting NO_2 disproportionates on Ba sites to form gaseous NO, and the "nitrite" route, in which NO is oxidized on Pt and is directly bound into nitrites on adjacent Ba sites. The second route prevails at high Ba coverages. Stored nitrates and nitrites can be reduced to NH_3.

H. Tanaka (Daihatsu Motor Co., Osaka, Japan) presented a perovskite-supported self-regenerating Pd catalyst reducing the toxicity of automobile exhaust to an exclusively low level. Under normal conditions, Pd in this catalyst can exist as ($LaFe_{0.57}Co_{0.38}Pd_{0.05}O_3$) and as supported metal (Pd/Al_2O_3). The perovskite forms in an oxidative atmosphere, and palladium metal exists in a reductive atmosphere. Undergoing segregation during the catalytic process, Pd is restructured and is removed by the flowing gas. A cyclic process has been developed in which the alternation of oxidation and reduction suppresses the growth of Pd particles. This process will make it possible to design an automotive afterburner capable of reducing the emission of noxious gases to a very low level.

E. Cauda (Torino Polytechnical Institute, Italy) reported the catalytic oxidation of soot particles in diesel exhaust. Many ceramic-supported La-containing perovskite catalysts have been tested. The $La_{0.8}Cr_{0.9}Li_{0.1}O_3$ catalyst, whose service life is 96 h at 450°C and 24 h at 650°C, best satisfies the activity and stability requirements. Its activity decreases under the action of SO_2, but the catalyst can easily be regenerated.

HOMOGENEOUS CATALYSTS, METAL COMPLEX CATALYSTS, AND BIOCATALYSTS FOR OXIDATION

The 5th Congress covered the field of homogeneous catalysis much more completely than did previous congresses. The simulation of enzymatic catalysis by metal complexes was considered in many works.

The plenary lecture by Lawrence Que (University of Minnesota, Minneapolis, United States) was devoted to hydrocarbon oxidation using non-heme iron catalysts. There are a variety of natural iron oxygenase enzymes capable of stereoselectively oxidizing C–H and C=C bonds. Cytochrome P-450, which is considered to be the prototype of the iron oxygenase, and various model complexes have been intensively studied over the last 25 years. Que systematically synthesized and studied non-heme iron complexes as iron dioxygenase models. In the last 5 years, he has discovered two families of complexes modeling enzymes, namely, Fe^{II}(BPMEN) and Fe^{II}(TPA). In these complexes, the hexacoordinated Fe^{II} atom is bonded to an N-containing ligand. These complexes catalyze the epoxidation of substrates with hydrogen peroxide, showing high stereoselectivity. Kinetic and mechanistic studies using ^{18}O isotopes and spectral studies have demonstrated that the non-heme iron complexes considered form $Fe^{III}OOH$ and, formally, $Fe^V{=}O$ intermediates. Depending on the nature of the ligand, olefin oxidation affords epoxide and diol in various ratios.

W. Nam (Center for Biomimetic Research, Seoul, Korea) delivered a problem-oriented lecture on a similar subject. Various forms of iron porphyrins have been synthesized to simulate the action of cytochrome P-450. Under olefin epoxidation and alkane hydroxylation conditions, the reactive intermediates are radical cations of oxo-Fe(IV) porphyrin resulting from the corresponding Fe^{II} complexes.

M. Newcomb (Illinois University, Chicago, United States) demonstrated, in his key lecture, that the laser flash photolysis of M=O derivatives produces high-valence transition metal complexes: $Mn^V{=}O$, $Fe^{IV}{=}O$, etc. These complexes can be intermediate compounds in photooxidation reactions.

The modern advances in the aerobic oxidation of hydrocarbons with *N*-hydroxylimides were reviewed in a key lecture presented by Y. Ishii (Kansai University, Osaka, Japan). The purpose of his work has been to develop new efficient methods for alkane oxidation to alcohols and carbonyl compounds. He reported in situ carbon radical generation at moderate temperatures by the reaction between dioxygen and *N*-hydroxyphthalimide (NHPI) in the presence or absence of Co or Mn. *para*-Xylene has selectively oxidized to terephthalic acid, cyclohexane has been oxidized to adipic acid, cyclohexane has been nitrated with NO_2, and other reactions have been carried out using NHPI as the catalyst.

H. Onitsuka (Kyushu University, Fukuoka, Japan) considered the aerobic oxidation of alcohols with (NO)Ru(sflen) complexes as catalysts. Chiral Ru complexes have been synthesized, which have made possible the asymmetric oxidation of initially disymmetric alcohols.

M. Tada (University of Tokyo, Japan) reported the discovery of the chiral self-dimerization of SiO_2-supported vanadium complexes. The resulting dinuclear vanadium complexes exhibit 100% selectivity and 90% enantioselectivity in the oxidative condensation of 2-naphthol. The structure of the supported complexes has been characterized by IR and UV–visible spectroscopy, XPS, ESR, and EXAFS and has been confirmed by DFT calculations.

Many reports were devoted to catalytic oxidation with H_2O_2 in the presence of coordination compounds. Search for efficient heterogeneous and homogeneous catalysts for benzene oxidation to phenol with oxygen is being continued. It was shown in many reports that the efficient hydroxylation of benzene with $H_2 + O_2$ mixtures yields H_2O_2 and hydroxyl radicals as intermediates. T. Sakamoto (Kansai University, Osaka, Japan) described the efficient hydroxylation of benzene to phenol in a $H_7PMo_8V_4O_{40} \cdot 24H_2O$ solution under the action of an air–CO mixture.

MISCELLANEOUS

Several reports at the Congress were devoted to the potential of so-called combinatorial analysis in catalysis or, in other words, to the development of fast methods for synthesis and simultaneous testing of a large number of catalysts under normal conditions, primarily in small apparatuses. For instance, in his plenary lecture, G.-J. Gruter (Avantium Technologies B.V., Amsterdam, the Netherlands) demonstrated a “catalytic platform” on which reactors for screening propane oxidation catalysts were mounted. Ninety-six catalysts of the same composition obtained under different drying and calcination conditions have simultaneously been tested using this equipment. A catalytic reactor consisting of 625 parallel channel reactors filled with catalyst grains was presented in the key lecture by F. Schütt (Institute for Coal Research, Mulheim, Germany). This reactor has been used in testing catalysts for hydrocarbon and CO oxidation in an H_2 medium. I.M. Margitfalvi (Institute of Surface Chemistry and Catalysis, Hungarian Academy of Sciences, Budapest, Hungary) reported the creation of a library of methane oxidation catalysts. The library is based on combinatorial laws (“holographic search strategy”). Using a special-purpose procedure, many mixtures of Ce, Zr, Co, Cr, La, Cu, Pt, Pd, and Au have been tested as catalysts in deep methane oxidation. The high-activity catalysts were found to contain no Cu, Zr, or Co.

The International Council on Catalytic Oxidation awarded prizes to two scientists known for their works on oxidation, namely, J. Haber (Poland) and M. Baerns (Germany). For many years, J. Haber headed the Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences (Krakow, Poland). For several years M. Baerns was the Director of the Institute for Applied Chemistry (Berlin, Germany). Both scientists delivered a brief prizewinner’s lecture. The lecture presented by J. Haber was devoted to electronic factors in oxidation reactions on semiconducting oxide catalysts. M. Baerns considered the application of combinatorial methods to selecting oxidation catalysts.

The lecture of P. Jacobs concerning liquid-phase oxidation on zeolites was not presented, because the reporter did not come to the Congress.

The next, 6th, Congress on Oxidation Catalysis will be held in Lille (France) in 2009.